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USE OF UNCONVENTIONAL RAW MATERIALS FOR PRODUCING SHEET GLASS BY VERTICAL DEBITENSE DRAWING

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The use of unconventional raw materials in glassmaking is demonstrated. Their compositions are investigated.

The choice of glass composition is based on the fact that molten glass must possess high production characteristics which ensure that the quality of the glass articles is high.

Sheet glasses lie in the composition range of the five-component system $\text{SiO}_2 - \text{Al}_2\text{O}_3 - \text{CaO} - \text{MgO} - \text{Na}_2\text{O}$. Silicon dioxide SiO_2 is the main component (about 72%). Different oxides in the composition of glass have an individual effect on the technological and production properties of molten glass, and consequently selecting the optimal composition of glass is a difficult problem. In this connection, the chemical composition of glass is determined by taking account of practical work, supplemented with the results of investigations directed toward further optimization of the compositions.

In the last 15 years it has become more difficult to provide manufacturers with high-quality raw materials for making glass. Consequently, one of the main directions of glass production is improving the quality of raw materials and improving the method for preparing the charge, since it is well known that a high-quality batch is half-founded molten glass. The technological requirements for glass raw materials are regulated in the normative-technological documentation. The main requirements for raw materials are constancy and uniformity of properties, high content of the main material, and limitation of the content of the iron oxides and other coloring impurities.

Only quartz sands — the main glass raw material — from individual deposits meet the requirements. On the whole, they must be enriched by various methods. Raw materials, as a rule, contain impurities which degrade the quality of the molten glass (oxides of iron, chromium, titanium, and manganese), and give glass an undesirable color or result in the formation of flaws.

The main criterion for the quality of raw materials is considered to be their content of iron oxides, which affect the

diathermancy of the molten glass and, correspondingly, the founding regime, and the production and quality of the glass. The balance of iron oxides which are introduced into glass with the raw materials with total iron content of 0.125% is as follows (%): sand — 0.061; dolomite — 0.012; feldspar — 0.026; sodium sulfate and soda — 0.001 each; iron from equipment — 0.01; refractories — 0.014. It is evident that quartz sand as well as feldspar and dolomite are responsible for the greatest contamination with iron.

Quartz sand contains primarily silicon dioxide. The most common impurities are iron, chromium, and titanium oxides. According to laboratory data, sand introduces into molten glass 0.003% chromium oxides and 0.3% titanium oxide, most of which are present in the finely dispersed fraction and clay component.

The Irbit Glass Works began to experience difficulties with deliveries of raw materials at the beginning of the 1990s. First, disruptions occurred in the deliveries of quartz sand from the Tashlinskoe deposit and dolomite from the Melekhovo-Fedotovskoe deposits. Under the conditions that developed the plant was forced to switch to sand from the Urals region — Mysovskoe and Bas'yanovskoe quarries. The sands from these quarries contained substantial impurities (%): up to 0.5 iron, up to 3.0 clay, and also up to 0.003 chromium and up to 0.7 titanium. In addition, the chemical composition of these sands was nonuniform; the SiO_2 and Fe_2O_3 fluctuations reached 2% and 0.2%, respectively.

The dolomite obtained from the Zaigraevskoe quarry (Siberian region) was close to the Melekhovo-Fedotovskoe dolomite with respect to the main material, but it contained up to 0.3% iron and had a different mechanical strength. The raw metallurgical dolomite from the Bilimbaevskoe deposit exhibited large fluctuations of the main component and possessed a high content of iron oxides (0.30 – 0.45%). When pulverized in a hammer crusher, the Fe_2O_3 content increased by an additional 0.10 – 0.15% because of metallic iron ground from the beaters in the crusher.

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Under these production conditions the Central Plant Laboratory had to provide a meticulous analysis, perform constant monitoring, and continually adjust the composition of the batch. Technological schemes for feeding raw material were carefully worked out, and the data obtained from chemical analyses were used to adjust and calculate the ratio of the materials being fed. Under these complicated conditions the component shop insured that the technical operations were performed precisely and that the mixed materials were fed in the prescribed proportions.

But since the beginning of 1995 it has become essentially impossible to use the dolomite from the Bilimbaevskoe quarry and sand from the Mysovskoe quarry: the FeO content increased sharply to 0.043% and the ratio FeO : Fe₂O₃ increased to 39% with total iron content 0.14 – 0.16%. In May the temperature at the bottom of the cooling part decreased by 40 – 50°C, the temperature of the onion-shaped dome decreased to 890 – 900°C, and the diathermancy index dropped to 5.6.

Under these conditions glass production was virtually impossible because of the sharp drop of the temperatures in the deformation zone and in the feed channel, and the molten glass in the basin no longer acquired heat because of the inadmissibly low diathermancy index of the melt.

In this difficult situation it was possible to gain control of the glass making process by regulating the oxidation – reduction potential of the glass melt and stabilizing the content of FeO and the ratio FeO : Fe₂O₃ at optimal values [1]. The reason for the disruption in the operation of the vertical glass drawing system was determined and the relationship between the change in the diathermancy, the content of different forms of iron, and the temperature regime of glassmaking was also determined [2].

The plant continued to search for new suppliers of raw material. The use of calcined soda from nepheline raw material for production started doing this period. The main problem in using this type of raw material was the variable contents of the main material and the accompanying impurities (K₂CO₃ and K₂SO₄). It became necessary to introduce more stringent corrections into the standard composition of the charge in order to maintain the prescribed content of Na₂O in the glass. However, the large amount of K₂O (up to 1.7%) on the whole had a favorable effect on the operation of the vertical glass drawing system: high rates of formation, stable motion of the glass ribbons, and correspondingly high production of the finish product [3].

Under conditions of the continual production, the technological service and the laboratory of the plant conducted this research work independently, accumulating and incorporating positive practical experience directly into the operating vertical glass drawing system. The positive results obtained from the investigations performed largely determine the subsequent successful operation of the enterprise.

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